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ISO/ [ballot stage] [standard number] - [part number] - [ballot cycle]

Document title: Proposal of New Process Data Model based on AP213

ABSTRACT:

This document is concerned in New Process Data Model for manufacturing mechanical product.
We have already investigated the data structure of New Process Data Model based on AP213.
At first, we show Basic Concept of New Process Data Model that we propose with this document.
Then, we show overviews of Data Structure about Machining Feature, Machining Process Data, Cutting Tool, Other Definitions, and Geometric Model Representation in New Process Data Model, comparing with the current AP213, AP224 and ISO14649.

KEYWORDS:

Process Planning
Machining Feature
AP213
AP224
ISO 14649(CNC Data Model)
ISO 13399(Small Tool)
Integrated AAM

COMMENTS TO READER:

This document is a discussion paper for Process Data Model of Manufacturing Process.
And this document was presented at Charleston ISO meeting.

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6. Geometric Model Representation

Oct., 2000

Chiaki Sakamoto

Komatsu Engineering

1. Basic Concept

(1) In Scope of Process Plan Activity
(The activity of Process Plan itself is Out of Scope in the current AP213)

(2) Description of both Engineering Data and Management Data
(The current AP213 can be used mainly for description of Management Data)

(3) Harmonization to ISO14649(CNC Data Model) and ISO13399(Small Tool)

2. Machining Feature

(1) To introduce “Machining Process Feature” instead of “NC Part Object”

(a) This “Machining Process Feature” can be mapped from AP224 Machining Feature automatically.

(b) The AP224 Machining Feature is defined as “Machining Design Feature” for Input Data of CAM.

(c) The definition of ISO14649 Machining Feature should be moved to this AP in future.

(2) To have No “Shape Aspect” between Feature and Geometry

(Geometry of Feature is defined only with “Shape Element”)

2. Machining Feature (continued)

(3) To have the following Attributes
- (a) Feature Relationship
- (b) Feature Dependency
- (c) Removal Volume of Feature
- (d) Geometric Tolerance of Feature and Dimensional Tolerance between Features
- (e) Surface Property of Feature
- (f) Machining Process(New Entity) and Workingsteps of ISO14649 for Feature

3. Machining Process Data

(1) To introduce “Machining Process” as
a collection of “Activities”

(There is no definition of “Machining Process ”
in the current AP213.)

(2) To refer “Workingstep” of ISO14649 instead of
“Material Removal”

(3) To categorize “Activity” into “Working Activity” and
“Setup Activity”

4. Cutting Tool

To refer “Cutting Tool” of ISO14649 and ISO13399 instead of “Tool Assembly” and “Tool Assembly Element”

(Now “Cutting Tool” for Milling is defined in ISO14649, but it will be integrated into ISO13399 in near future.)

5. Other Definitions

To use the Definitions of the current AP213 basically for the following Data

(a) Manufacturing Resource Data (Work Cell, Machine, etc.)

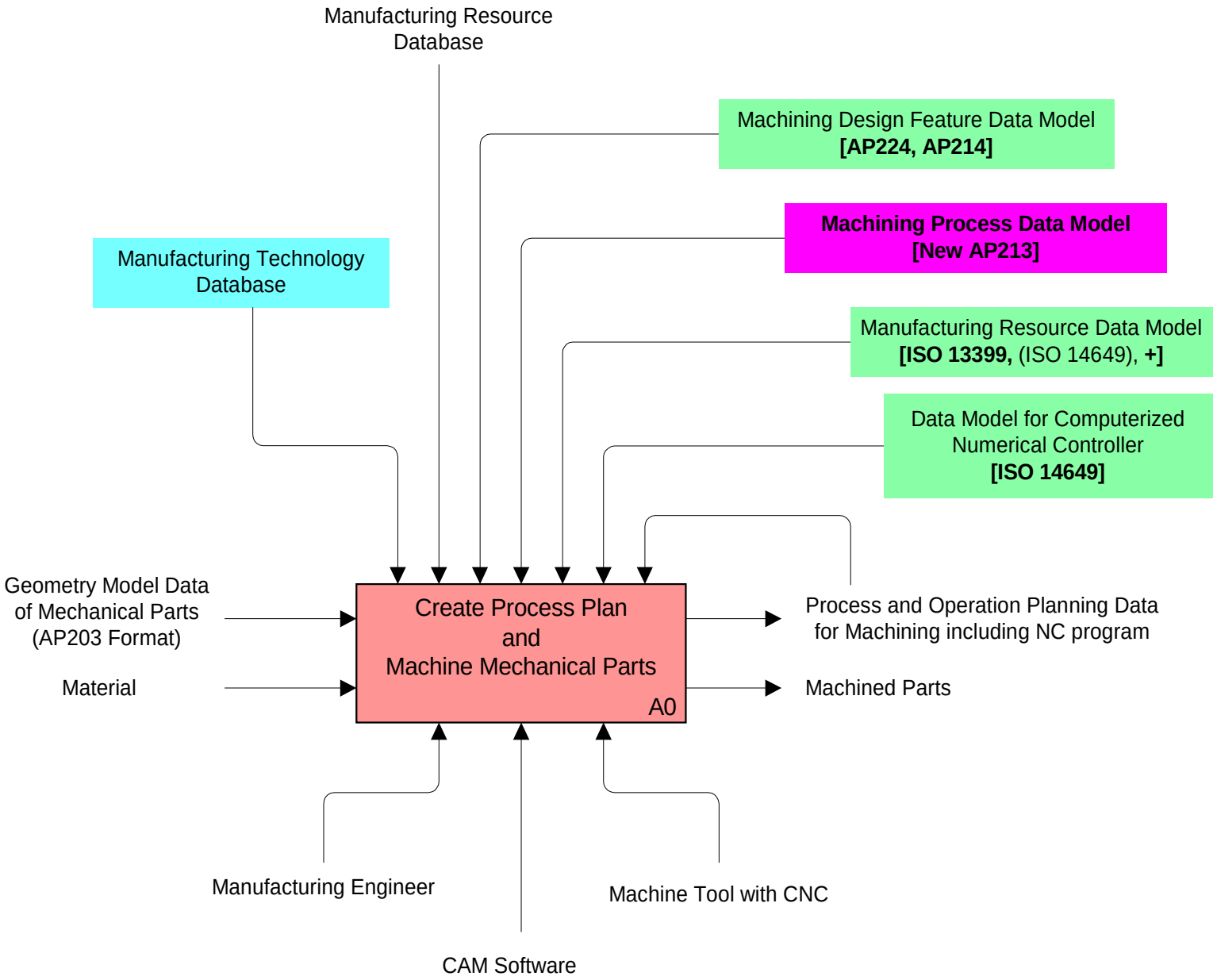
(b) Administrative Data (Revision, Security, etc.)

6. Geometric Model Representation

To have the following Models as same as the current AP213

(a) Manifold Surface with Topology
(b) Wireframe with Topology
(c) Facetted B-rep
(d) Advanced B-rep
(e) Non topological Surface and Wireframe

(AP224 has only Advanced B-rep)



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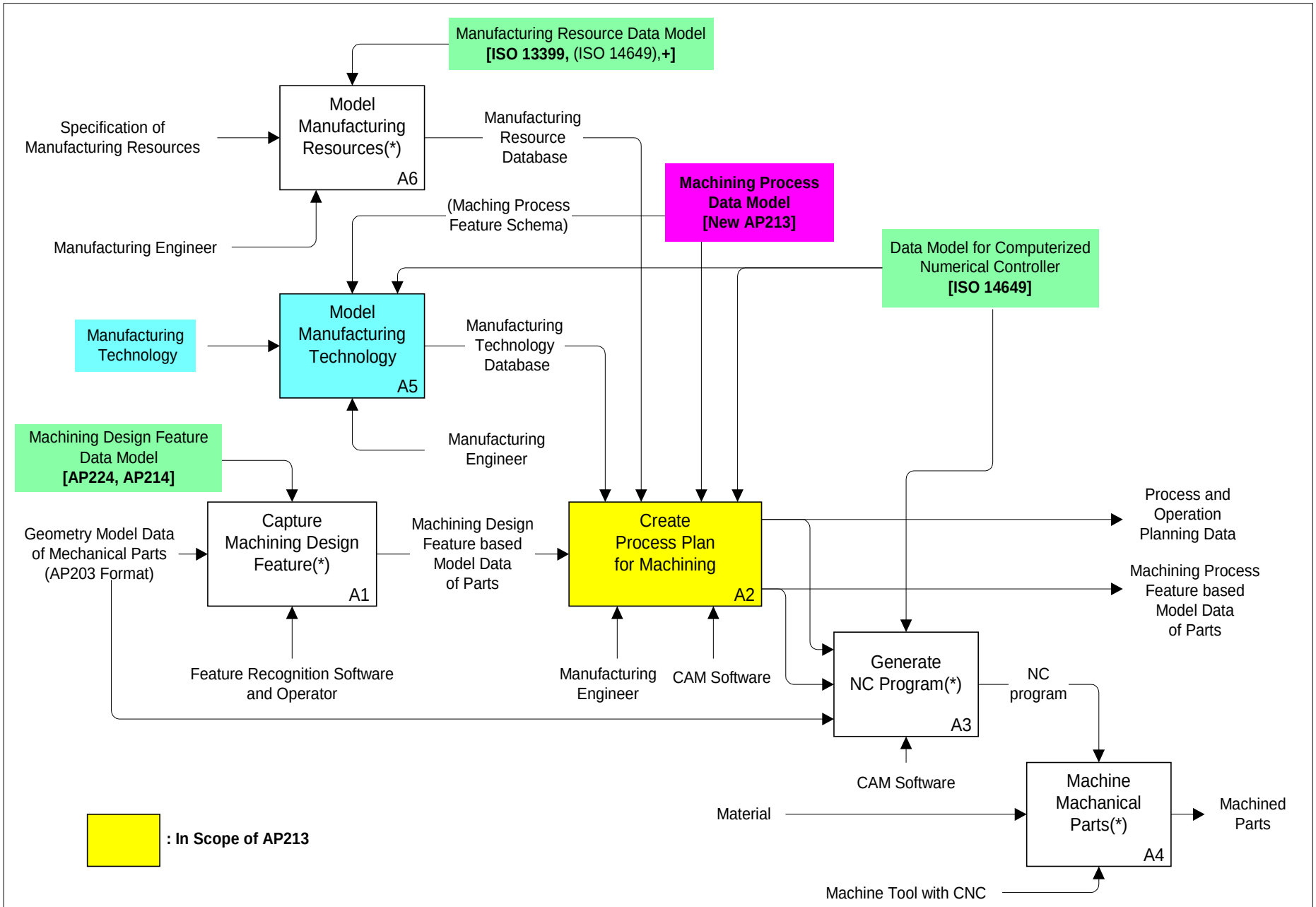

Node: A0	Title: Create Process Plan and Machine Mechanical Parts	Number: 2

Comparison between New AP213 and Other Data Models

→ : Reference to ISO 14649

← : Reference to AP213

		Current AP213	New AP213	ISO 14649(CNC Data Model)	AP224
Machining Feature Schema	Category		**Machining Process Feature**	**Machining Process Feature**	**Machining Design Feature**
	Attribute		1. Attributes for each Feature **(Removal Volume of Feature)** **2. Relationship between Features**	Attributes for each Feature	Attributes for each Feature
Machining Process Schema	MachiningProcess	Activity_group (No Definition of Process)	**Machining_process** **(which has its Definition)**	Workplan (No Definition of Process)	
	MachiningOperation	Material_removal (One of Activities)	→	**Machining_workingstep**	
	MachiningOperation Data	**Performance_rate** (Allowed_time, Production_rate) **[No Category of Engineering Data]**	→ ←	**Machining_operation, Machining_strategy, Technology, Machine_functions, etc**	
	Other Operations	Validation, Machine_setup, Part_loading, Part_handling	←	Touch_probing	
Manuf. Resource Schema	Machine Tool	**Work_cell, Workstation, Machine, Tool_magazine_turret_carousel**	←		
	Cutting Tool	Tool_assembly Tool_assembly_element (No Category of Tool)	→	**Cutting_tool** (which has Category of Tool_body)	
	Fixture	Fixture_assembly Fixture_assembly_element	**Clamping Position**		
Management Data		**Revision, Security,** etc	←		Project_order, Approval, etc
Property		Surface_finish of NC_part_object	→	**Surface_finish of Feature**	**Surface_propery of Geometry, Material_property, etc**
Tolerance		NC_tolerance (inside, outside, total)	**Tolerance between Features** (with simplified Expression)	Tolerance for Length	**Geometric Tolerance and Dimensional Tolerance**
Usage		**Management Data**	**Engineering and Management Data**	**Engineering Data**	**Engineering and Management Data**
		Output from Process Plan	Output from Process Plan	Input for CNC	Input for Process Plan

Data Structure of New Process Data Model based on AP213

[EXPRESS_G Diagram]

Oct., 2000

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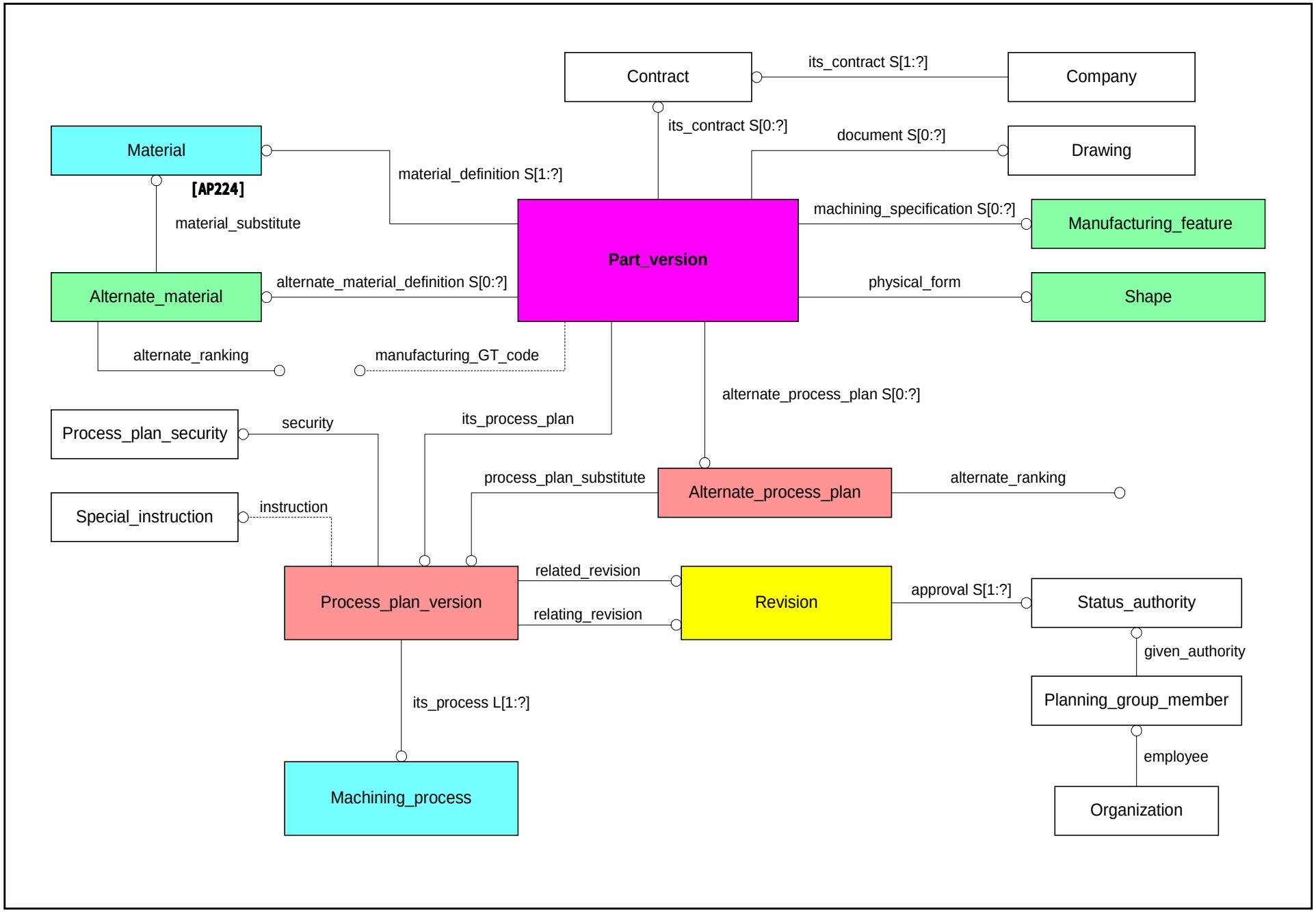
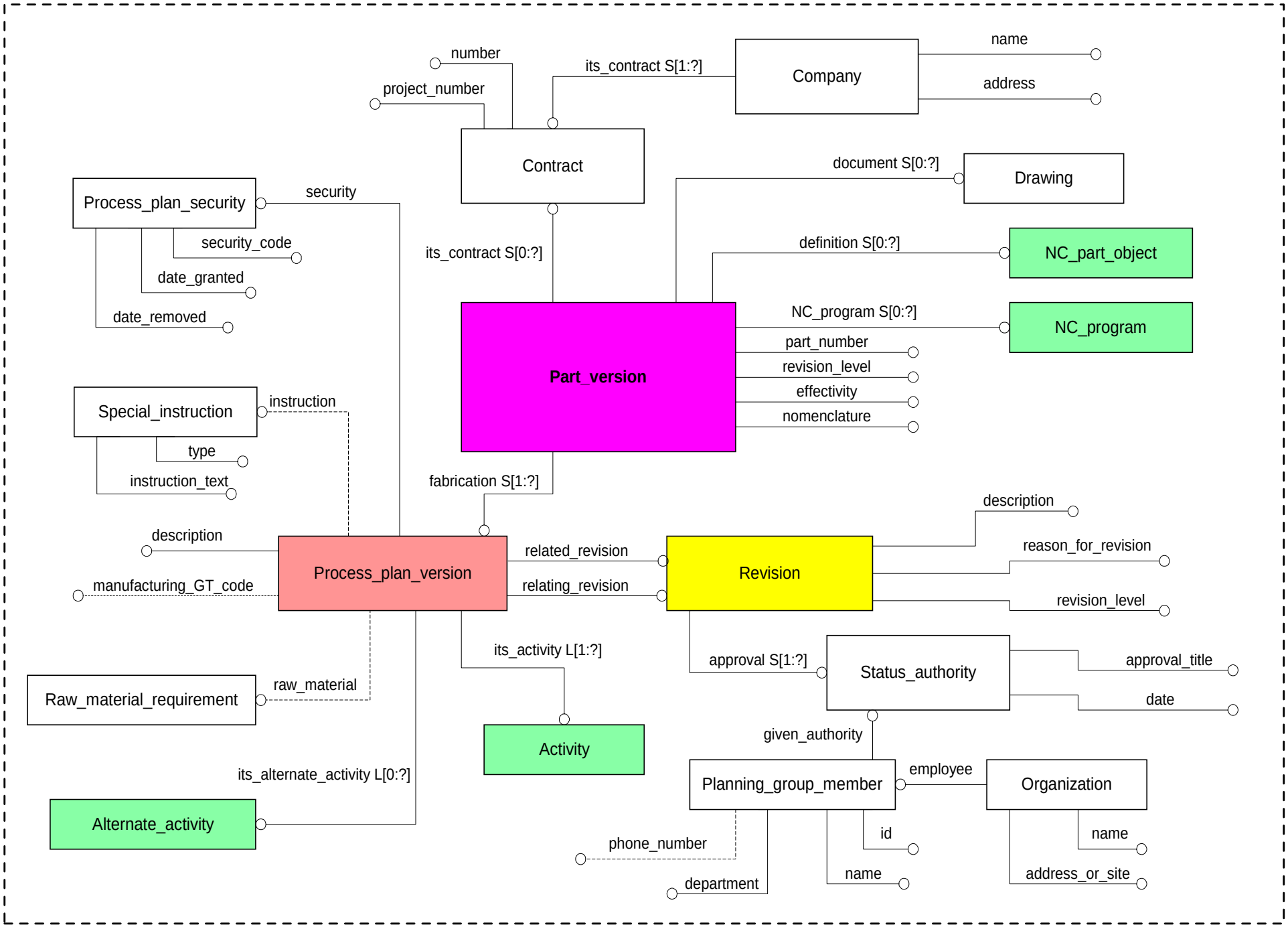
Komatsu Engineering, Japan

Part Version



AP213 Part Version



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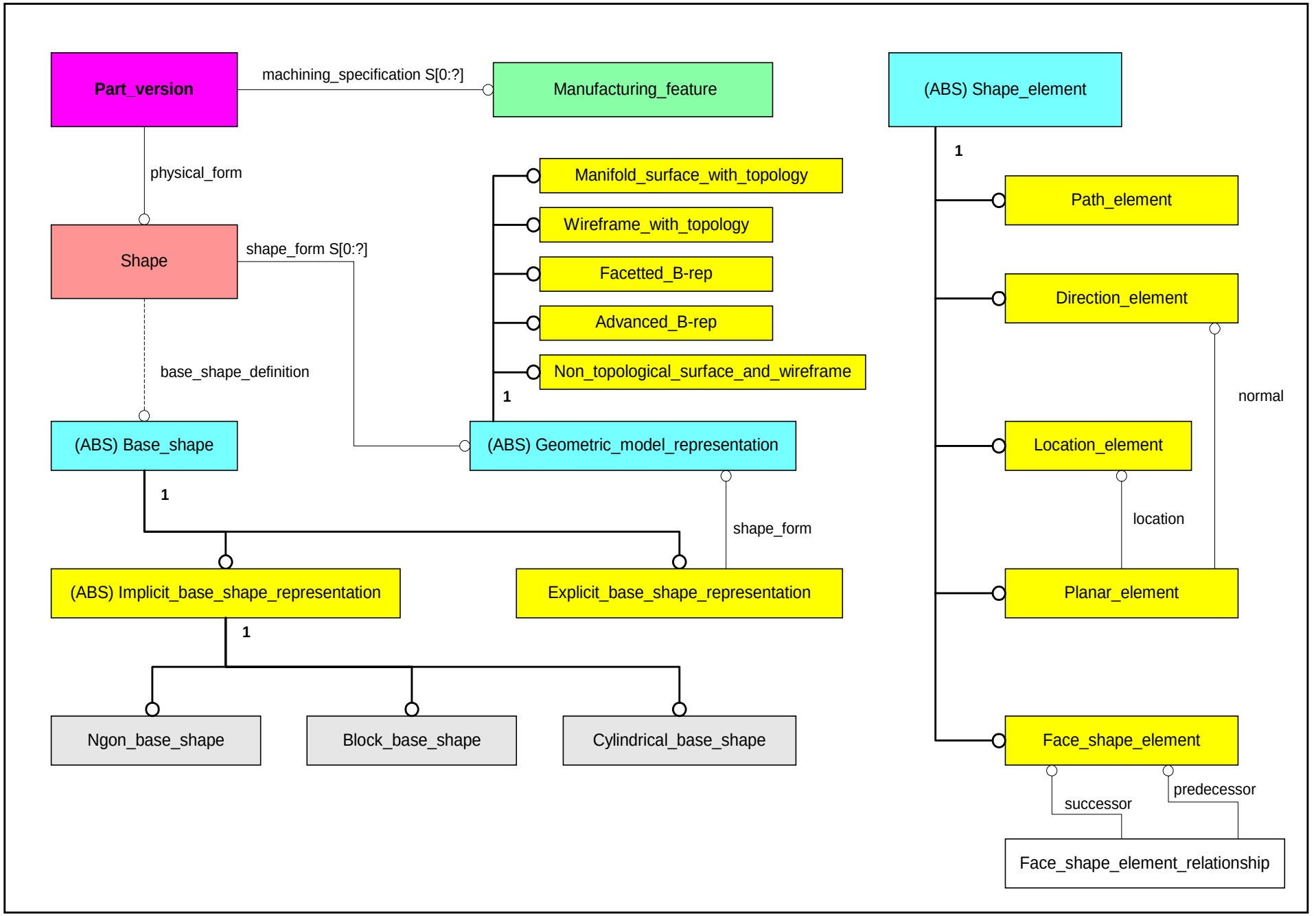
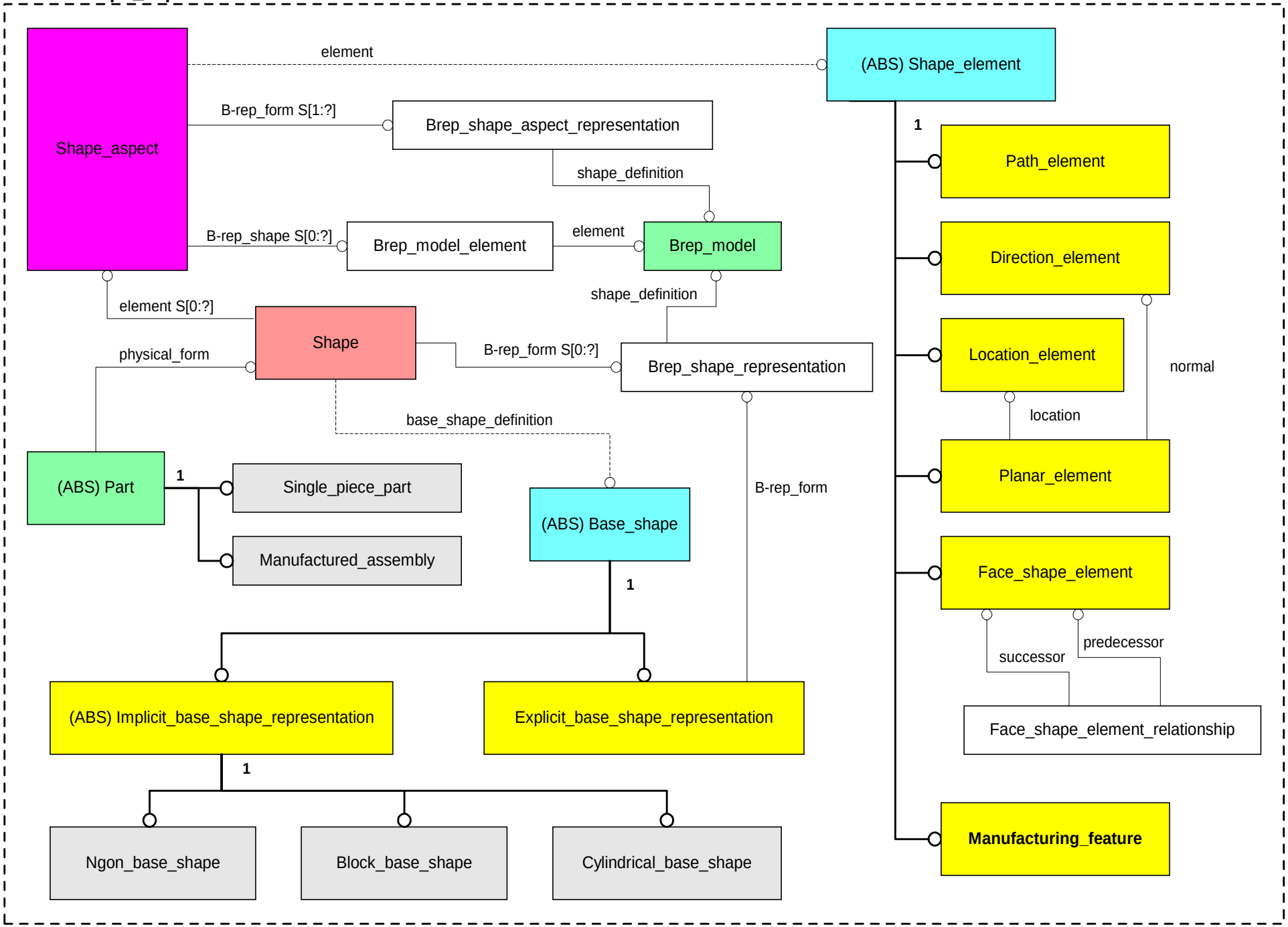
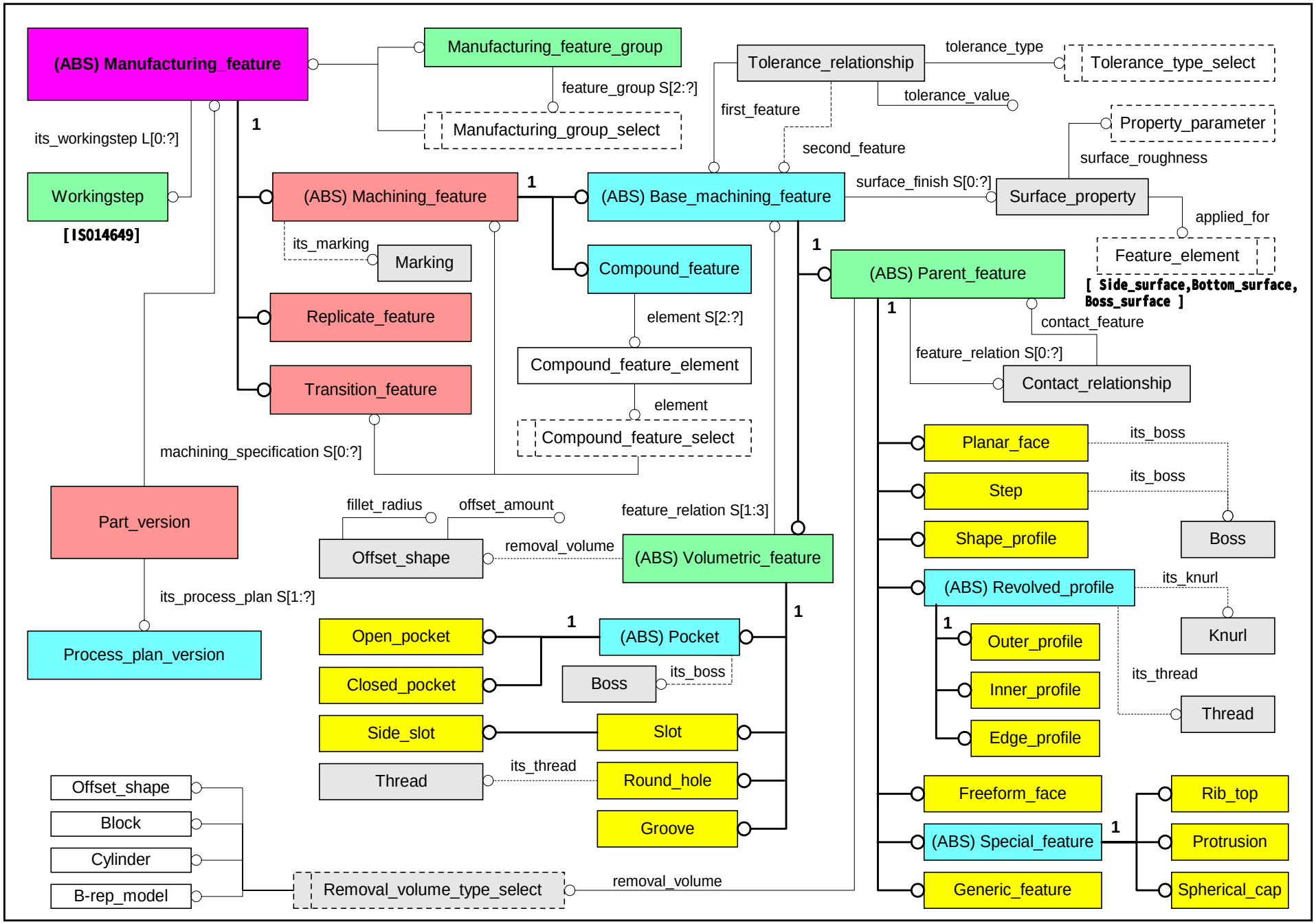


AP224 Shape_aspect

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feature_group S[2:?]
Manufacturing_group_select
its_workingstep L[0:?]
1
Workingstep
[ISO14649]
(ABS) Machining_feature
1
(ABS) Base_machining_feature
Tolerance_relationship
tolerance_type
Tolerance_type_select
tolerance_value
first_feature
second_feature
Property_parameter
surface_roughness
surface_finish S[0:?]
Surface_property
applied_for
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[Side_surface,Bottom_surface, Boss_surface]
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Marking
Compound_feature
1
(ABS) Parent_feature
Replicate_feature
element S[2:?]
Compound_feature_element
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contact_feature
feature_relation S[0:?]
Contact_relationship
Transition_feature
element
Compound_feature_select
machining_specification S[0:?]
Planar_face
its_boss
Step
its_boss
Part_version
fillet_radius
offset_amount
feature_relation S[1:3]
Shape_profile
Boss
Offset_shape
removal_volume
(ABS) Volumetric_feature
(ABS) Revolved_profile
its_knurl
its_process_plan S[1:?]
1
1
Knurl
Open_pocket
1
(ABS) Pocket
1
Outer_profile
Process_plan_version
Closed_pocket
Boss
its_boss
its_thread
Inner_profile
Side_slot
Slot
Thread
Edge_profile
Thread
its_thread
Round_hole
Offset_shape
Freeform_face
Rib_top
Block
Groove
1
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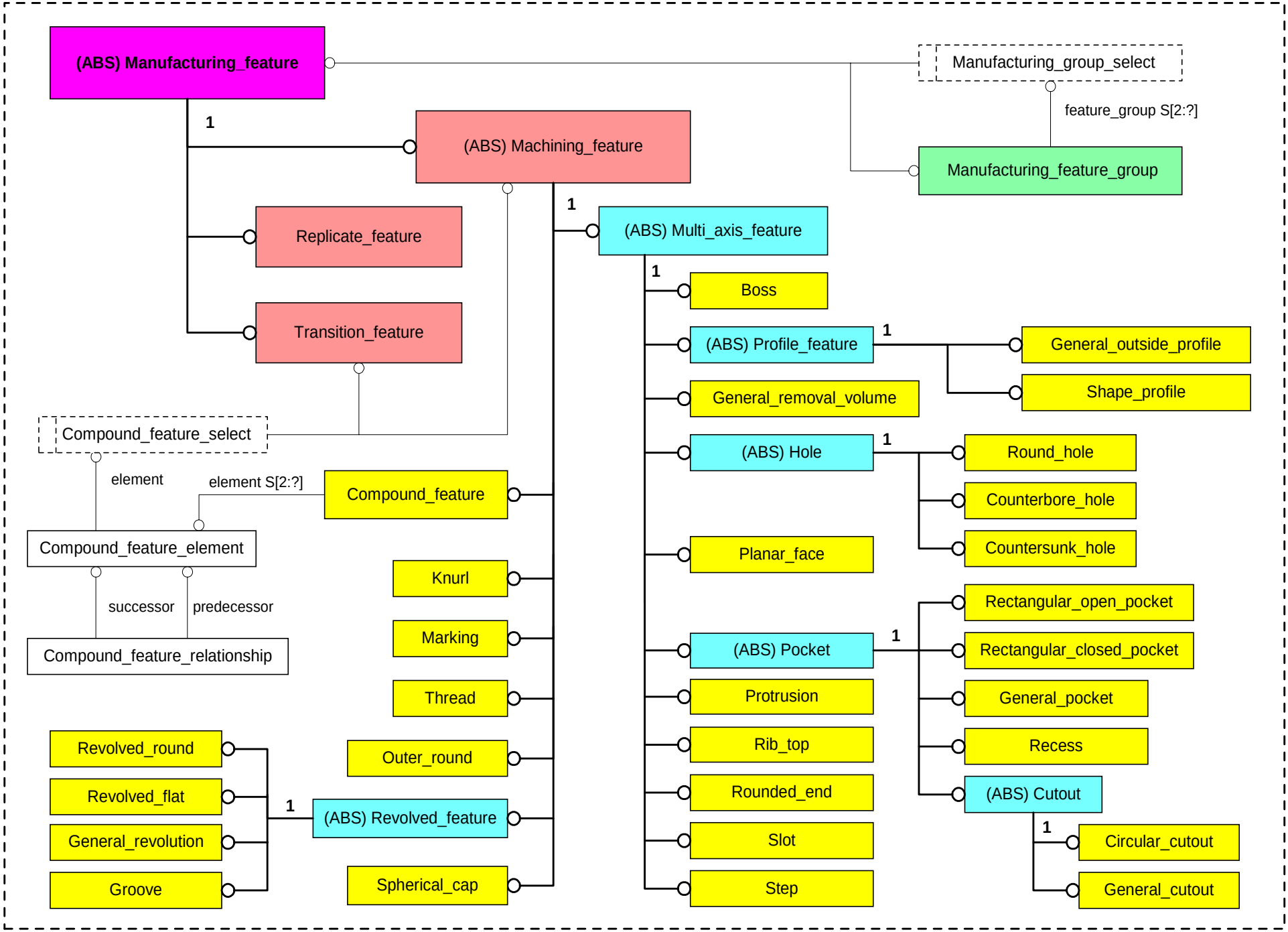
Protrusion
B-rep_model
Removal_volume_type_select
removal_volume
Generic_feature
Spherical_cap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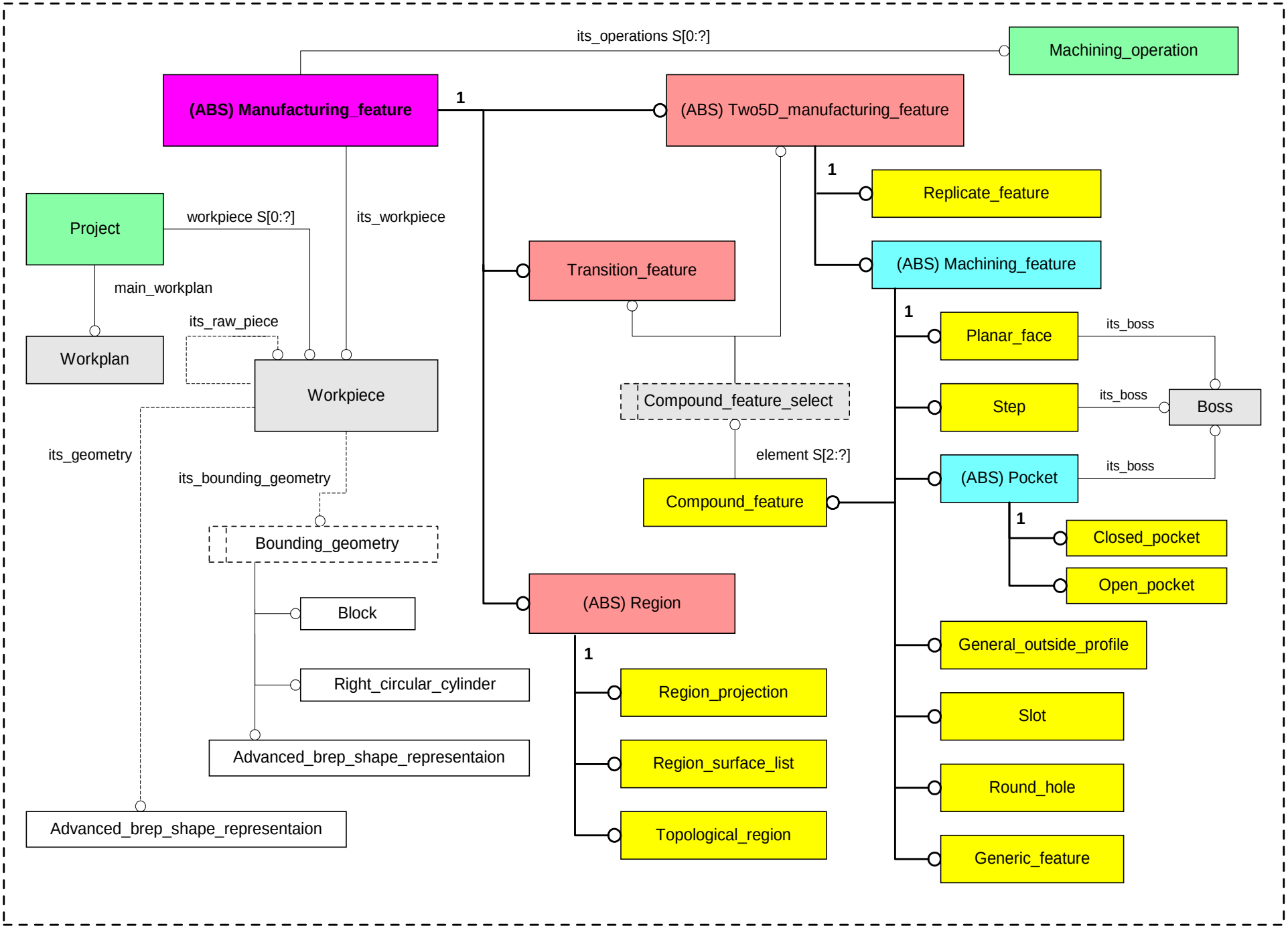
Manufacturing_group_select
feature_group S[2:?]
Manufacturing_feature_group
1
(ABS) Machining_feature
Replicate_feature
Transition_feature
1
(ABS) Multi_axis_feature
1
Boss
(ABS) Profile_feature
1
General_outside_profile
Shape_profile
General_removal_volume
(ABS) Hole
1
Round_hole
Counterbore_hole
Countersunk_hole
Planar_face
Compound_feature_select
element
element S[2:?]
Compound_feature
Compound_feature_element
successor
predecessor
Compound_feature_relationship
Knurl
Marking
Thread
Outer_round
Spherical_cap
Revolved_round
Revolved_flat
General_revolution
Groove
1
(ABS) Revolved_feature
(ABS) Pocket
1
Rectangular_open_pocket
Rectangular_closed_pocket
General_pocket
Recess
(ABS) Cutout
1
Circular_cutout
General_cutout
Protrusion
Rib_top
Rounded_end
Slot
Step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Machining_operation
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1
(ABS) Two5D_manufacturing_feature
1
Replicate_feature
Project
workpiece S[0:?]
its_workpiece
Transition_feature
(ABS) Machining_feature
main_workplan
its_raw_piece
1
Planar_face
its_boss
Workplan
Workpiece
Compound_feature_select
Step
its_boss
Boss
its_geometry
element S[2:?]
(ABS) Pocket
its_boss
its_bounding_geometry
Compound_feature
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Bounding_geometry
Closed_pocket
Open_pocket
(ABS) Region
Block
General_outside_profile
1
Right_circular_cylinder
Region_projection
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Region_surface_list
Round_hole
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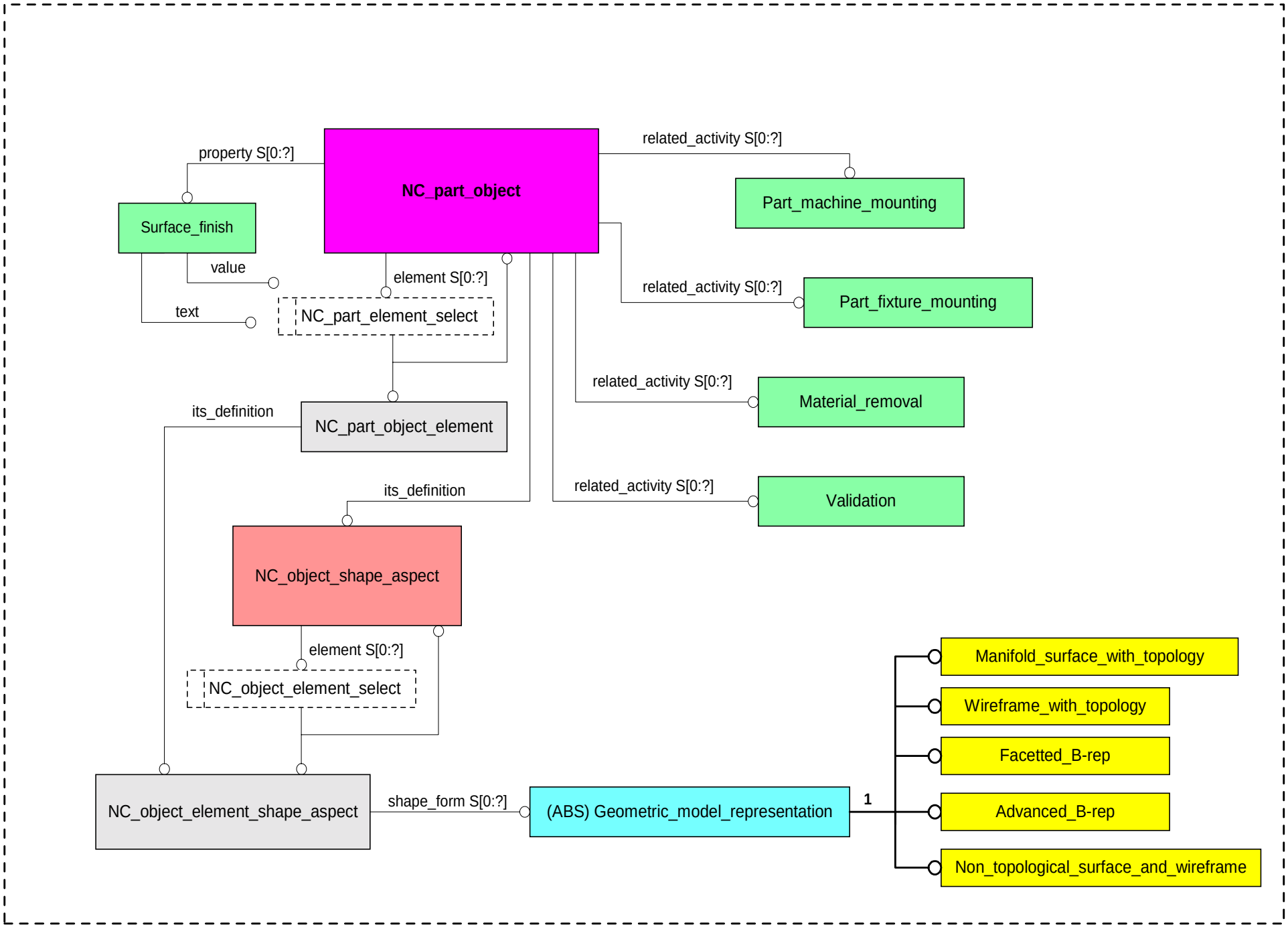
Topological_region
Generic_feature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NC_part_object
related_activity S[0:?]
Part_machine_mounting
Surface_finish
value
element S[0:?]
related_activity S[0:?]
Part_fixture_mounting
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NC_part_element_select
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Material_removal
its_definition
NC_part_object_element
its_definition
related_activity S[0:?]
Validation
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element S[0:?]
NC_object_element_select
Manifold_surface_with_topology
Wireframe_with_topology
Facetted_B-rep
Advanced_B-rep
Non_topological_surface_and_wireframe
NC_object_element_shape_aspect
shape_form S[0:?]
(ABS) Geometric_model_representation
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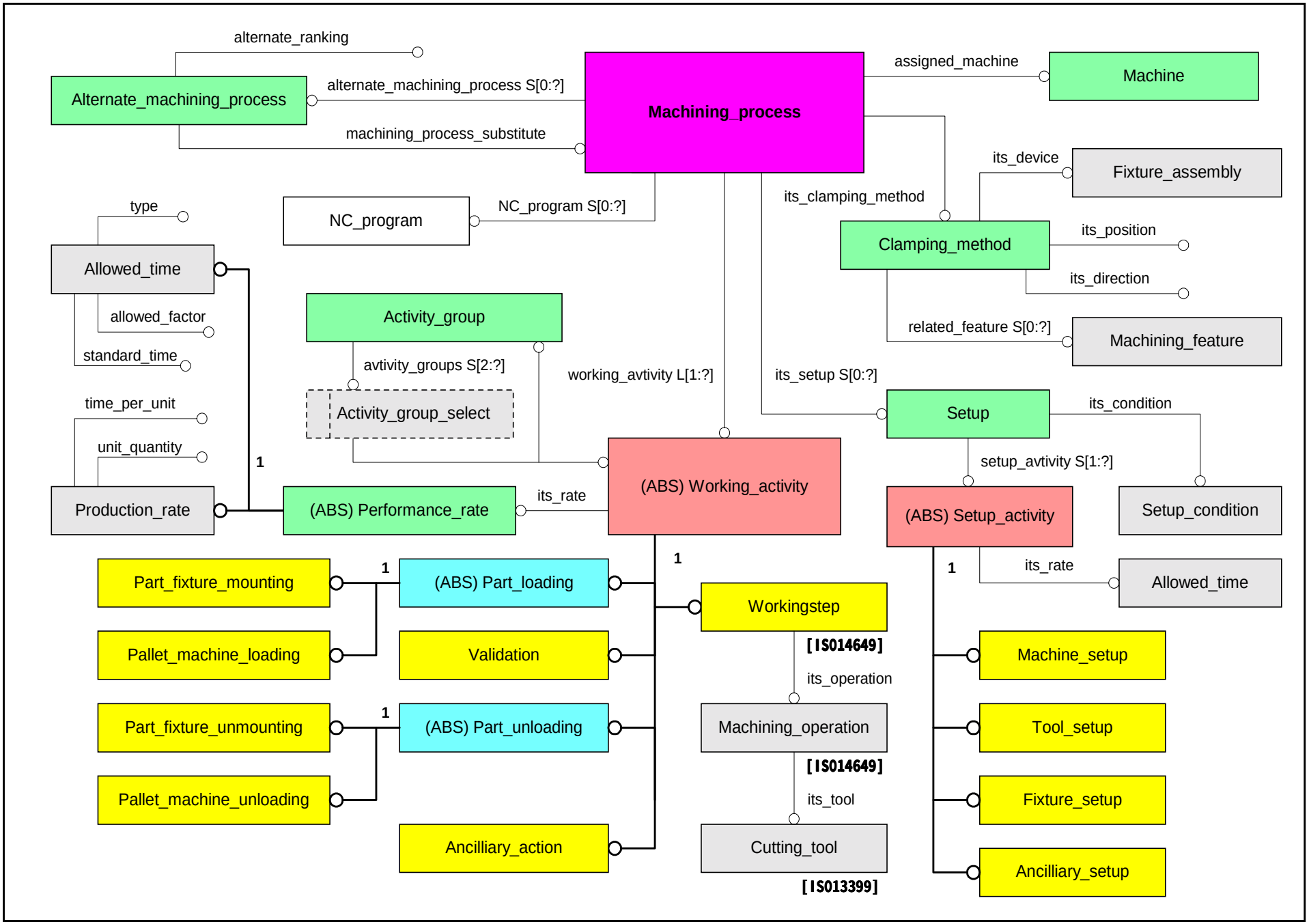
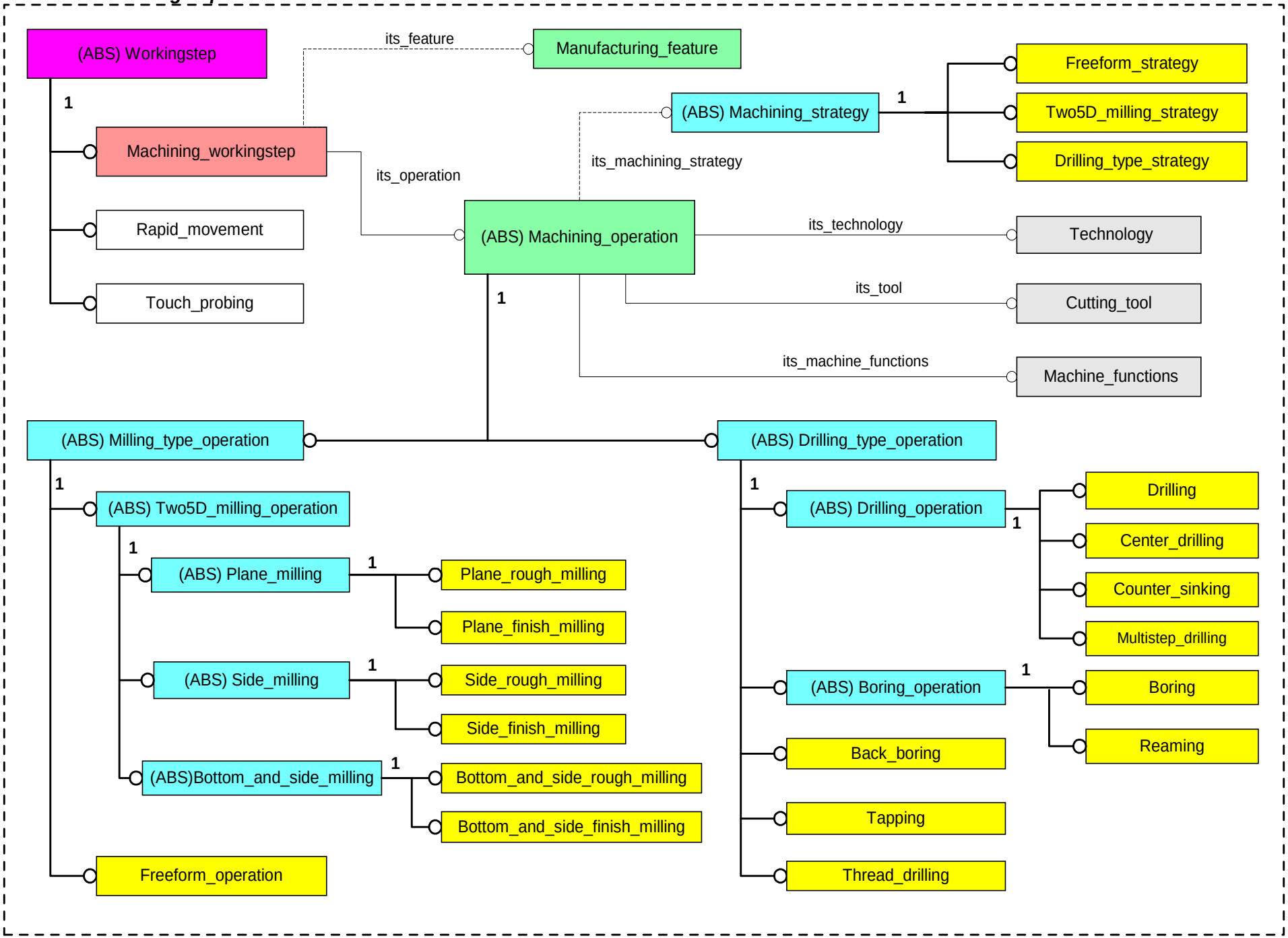

alternate_ranking
Alternate_machining_process
alternate_machining_process S[0:?]
Machining_process
assigned_machine
Machine
machining_process_substitute
its_device
Fixture_assembly
its_clamping_method
type
NC_program
NC_program S[0:?]
Clamping_method
its_position
Allowed_time
its_direction
allowed_factor
Activity_group
related_feature S[0:?]
Machining_feature
standard_time
avtivity_groups S[2:?]
working_avtivity L[1:?]
its_setup S[0:?]
time_per_unit
Activity_group_select
Setup
its_condition
unit_quantity
1
setup_avtivity S[1:?]
Production_rate
(ABS) Performance_rate
its_rate
(ABS) Working_activity
(ABS) Setup_activity
Setup_condition
Part_fixture_mounting
1
(ABS) Part_loading
1
1
its_rate
Allowed_time
Workingstep
Pallet_machine_loading
Validation
[IS014649]
Machine_setup
its_operation
Part_fixture_unmounting
1
(ABS) Part_unloading
Machining_operation
Tool_setup
[IS014649]
Pallet_machine_unloading
its_tool
Fixture_setup
Ancilliary_action
Cutting_tool
Ancilliary_setup
[IS013399]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Manufacturing_feature
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Machining_workingstep
(ABS) Machining_strategy
1
Freeform_strategy
Two5D_milling_strategy
Drilling_type_strategy
its_machining_strategy
its_operation
Rapid_movement
(ABS) Machining_operation
its_technology
Technology
Touch_probing
1
its_tool
Cutting_tool
its_machine_functions
Machine_functions
(ABS) Milling_type_operation
(ABS) Drilling_type_operation
1
(ABS) Two5D_milling_operation
1
(ABS) Plane_milling
1
Plane_rough_milling
Plane_finish_milling
(ABS) Side_milling
1
Side_rough_milling
Side_finish_milling
(ABS)Bottom_and_side_milling
1
Bottom_and_side_rough_milling
Bottom_and_side_finish_milling
Freeform_operation
1
(ABS) Drilling_operation
1
Drilling
Center_drilling
Counter_sinking
Multistep_drilling
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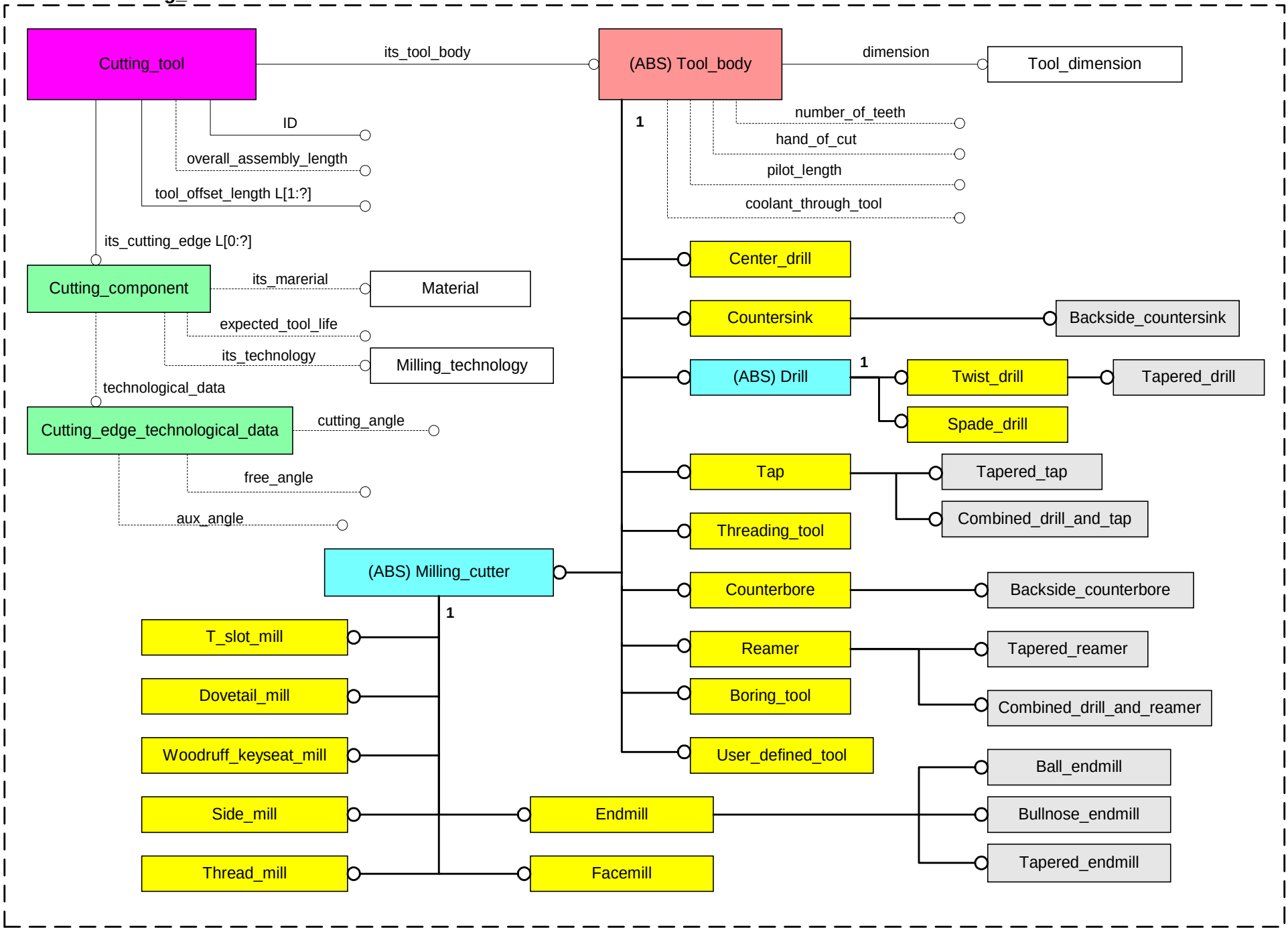
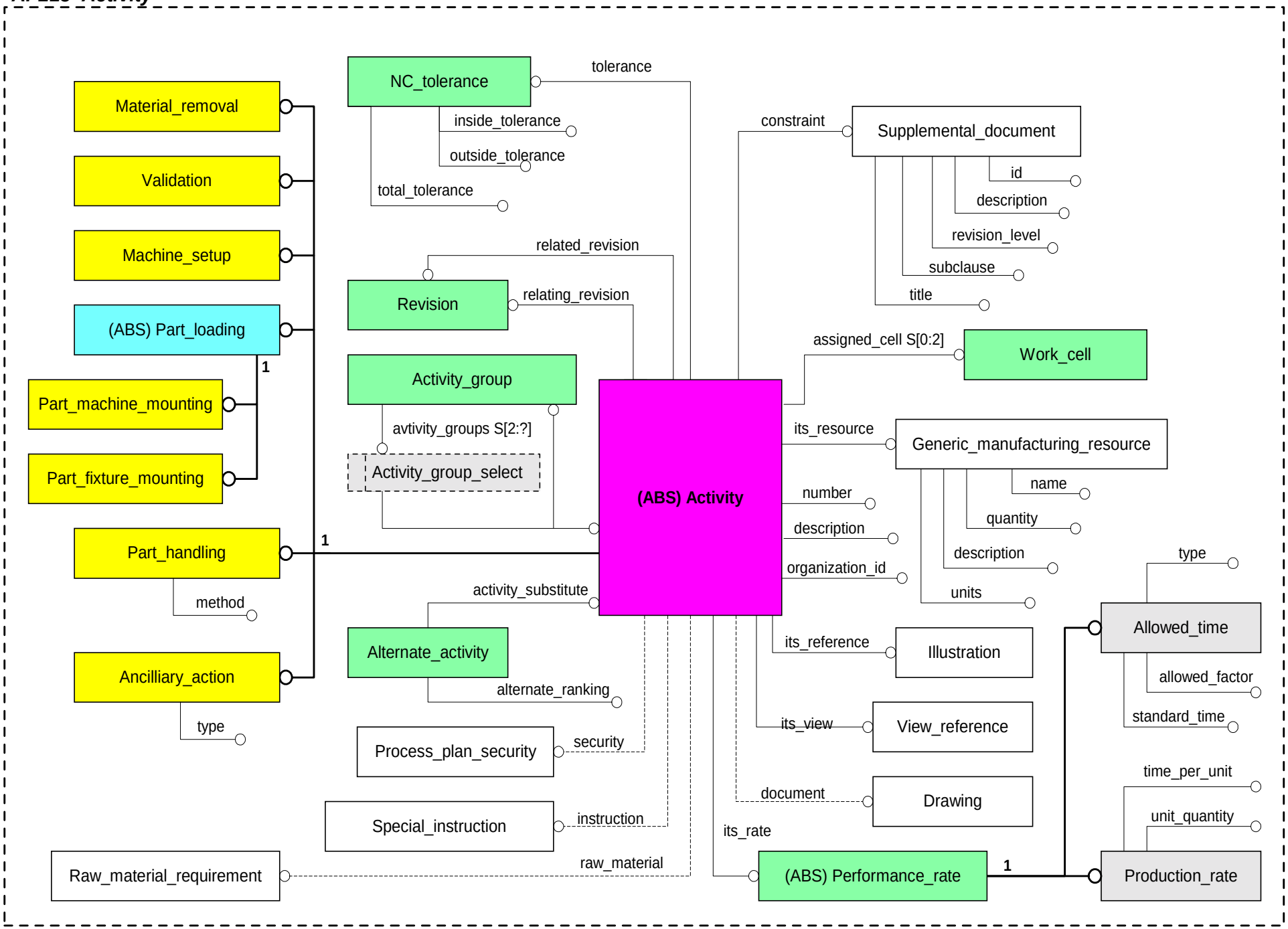
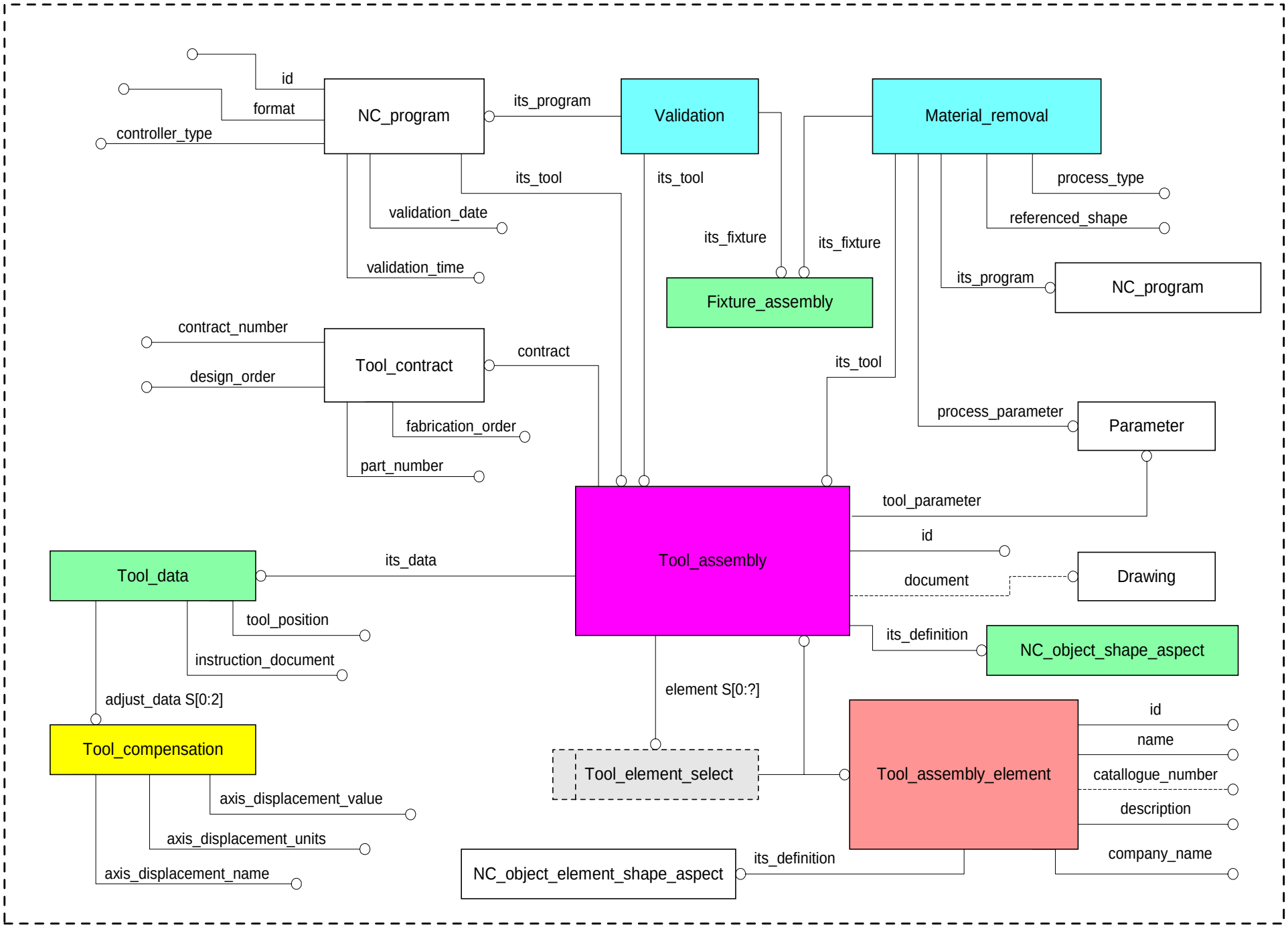
1
Boring
Reaming
Back_boring
Tapping
Thread_drilling

ISO14649_Cutting_tool



AP213 Activity




id
format
controller_type
NC_program
its_program
Validation
Material_removal
its_tool
its_tool
validation_date
validation_time
its_fixture
its_fixture
Fixture_assembly
process_type
referenced_shape
its_program
NC_program
contract_number
design_order
Tool_contract
contract
fabrication_order
part_number
its_tool
process_parameter
Parameter
tool_parameter
id
document
Drawing
Tool_assembly
its_data
Tool_data
tool_position
instruction_document
adjust_data S[0:2]
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NC_object_shape_aspect
element S[0:?]
Tool_compensation
Tool_element_select
Tool_assembly_element
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catallogue_number
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company_name
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axis_displacement_name
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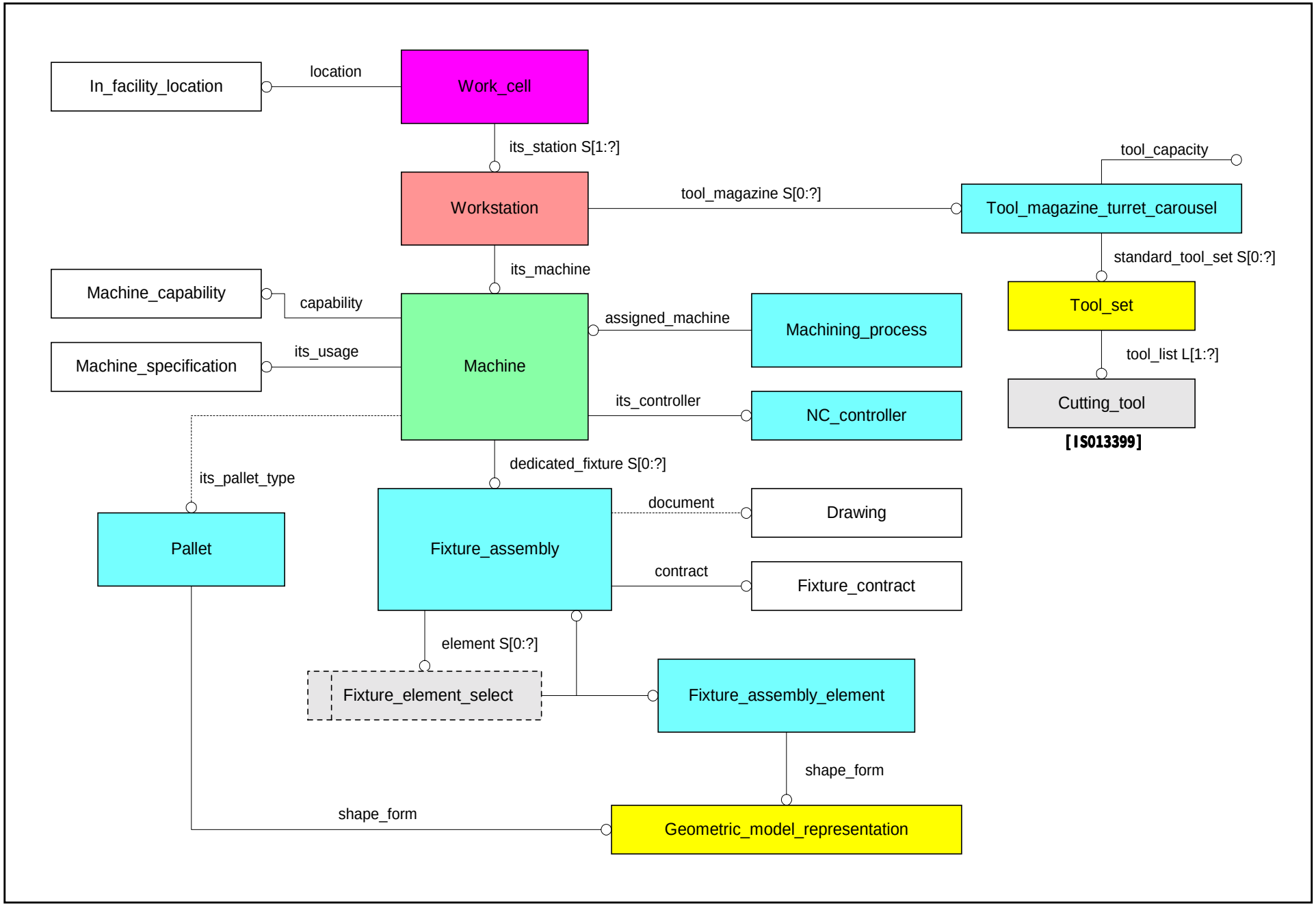
its_definition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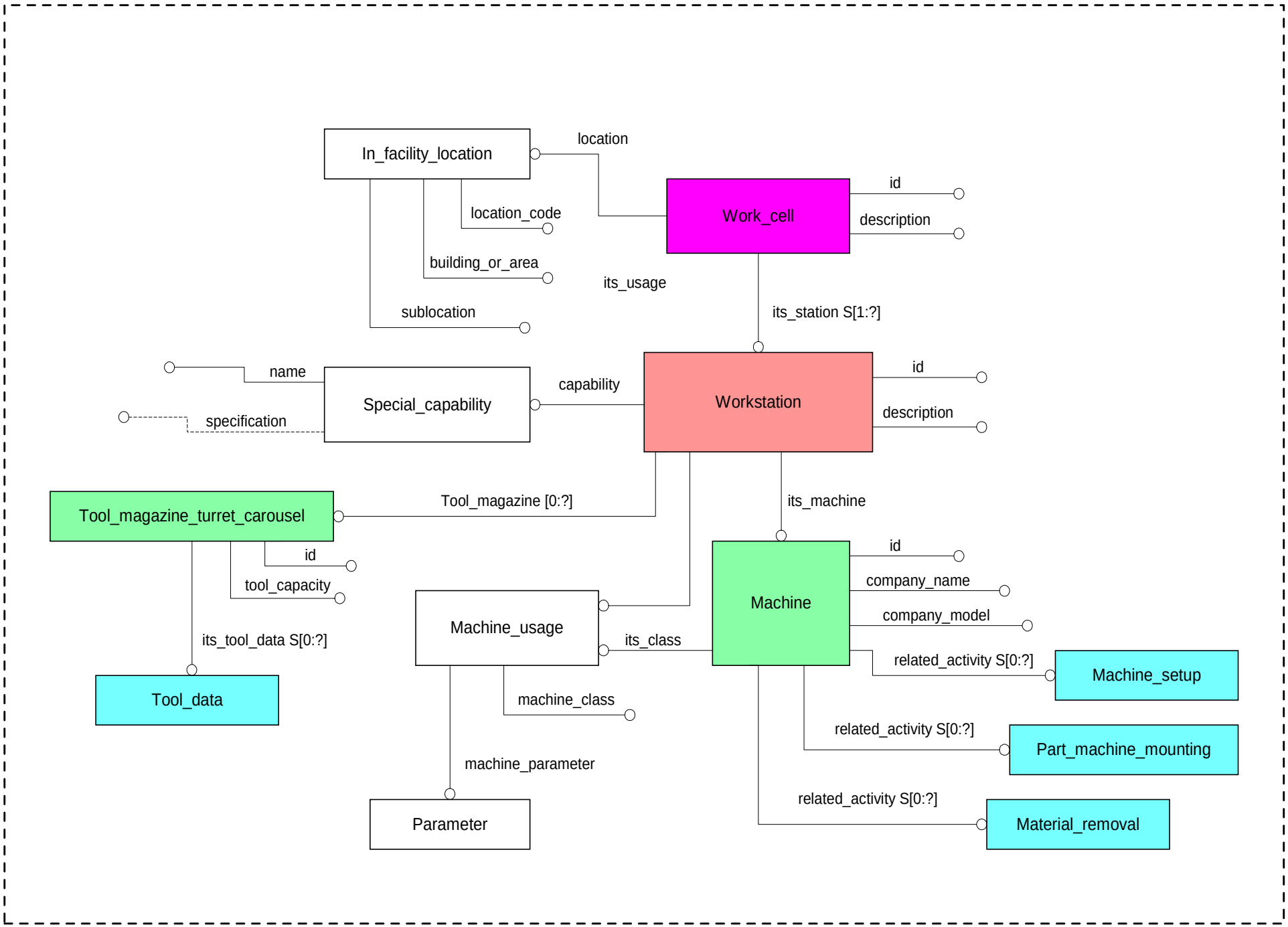
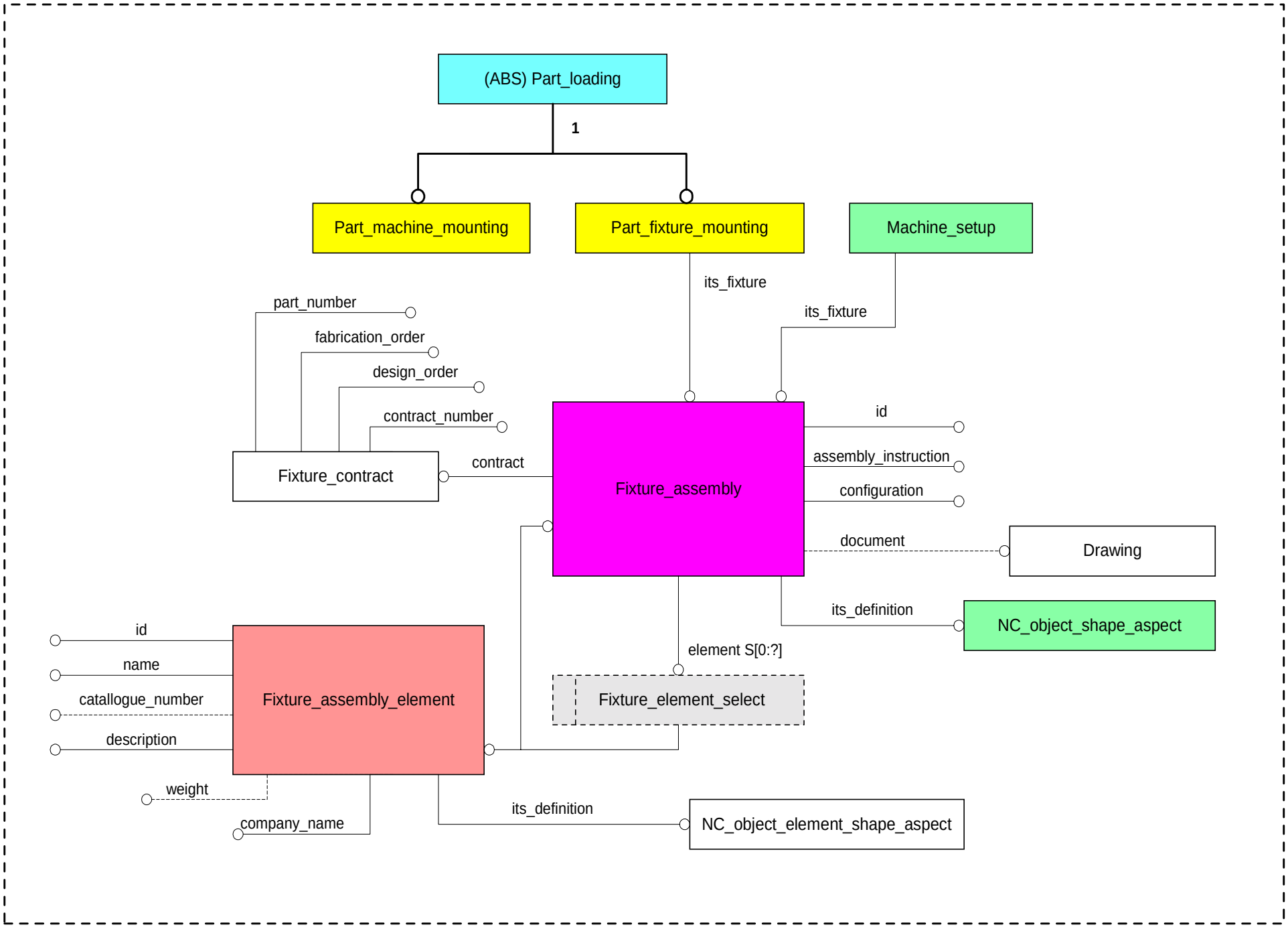
location
Work_cell
its_station S[1:?]
Workstation
tool_magazine S[0:?]
tool_capacity
Tool_magazine_turret_carousel
standard_tool_set S[0:?]
Tool_set
tool_list L[1:?]
Cutting_tool
[ISO13399]
Machine_capability
capability
its_machine
Machine_specification
its_usage
Machine
assigned_machine
Machining_process
its_controller
NC_controller
its_pallet_type
dedicated_fixture S[0:?]
Pallet
Fixture_assembly
document
Drawing
contract
Fixture_contract
element S[0:?]
Fixture_element_select
Fixture_assembly_element
shape_form
shape_form
Geometric_model_representation


In_facility_location
location
location_code
building_or_area
sublocation
Work_cell
id
description
its_usage
its_station S[1:?]
name
specification
Special_capability
capability
Workstation
id
description
Tool_magazine_turret_carousel
Tool_magazine [0:?]
its_machine
id
tool_capacity
its_tool_data S[0:?]
Tool_data
Machine_usage
its_class
machine_class
machine_parameter
Parameter
Machine
id
company_name
company_model
related_activity S[0:?]
Machine_setup
related_activity S[0:?]
Part_machine_mounting
related_activity S[0:?]
Material_removal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1
Part_machine_mounting
Part_fixture_mounting
Machine_setup
its_fixture
its_fixture
part_number
fabrication_order
design_order
contract_number
Fixture_contract
contract
Fixture_assembly
id
assembly_instruction
configuration
document
Drawing
its_definition
NC_object_shape_aspect
element S[0:?]
Fixture_element_select
id
name
catallogue_number
description
Fixture_assembly_element
weight
company_name
its_definition
NC_object_element_shape_aspect